

Effects of National Strategic Policy on the Military Engineer Force Structure from 1919 through 1991

A Monograph

by

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Abstract

Affects of National Strategic Policy on the Military Engineer Force Structure from 1919 through 1991 by Major Aaron D. Bohrer, U.S. Army, 51 pages.

National strategic policy and strategic military leadership affected the engineer force structure over the last 90 years despite little change to the mission of the military engineer. Regardless of force structure issues, engineers performed their unchanging missions of general engineering, mobility, counter mobility, and survivability in support of both their specific service and other services. Additionally, the requirement to provide cross-service support while supporting their specific service shaped military leaders' concept of what engineers do for the force. Unfortunately, this created a perception that all engineers are alike and that their missions are the same across services.

The changes in strategic policy also shaped the expertise of each service's engineers as the services determined their mission requirements for the time. As a general trend, the Army and Marines developed their tactical combat engineering skills, while the Navy and Air Force mission requirements called for general engineering expertise. The historical shaping effects on each service's engineers also created redundant skills across the military as each service struggled to determine the specific requirements of their engineer force. These issues still affect the current military engineer force structure.

Currently, senior engineer leaders within the United States military are coping with limited assets, increasing requirements, increasing operational deployments, and decreasing budgets. A recent proposal from the Army War College has suggested an expansion of the current Inter-service Training Review Organization (ITRO) program that focuses on more unified training for military engineers. In theory, this gives the same skill sets to all military construction engineers and some combat engineers thus making a military engineer who can execute the general engineer requirements of all four services. Another War College proposal has called for a "more joint" approach to training, acquisitions and interpretability that allows for efficiency and eliminates perceived redundancies in engineering specific skills. While these proposals make sense fiscally, the supporters of these courses of action may not have fully considered the historical context of the development of the various engineer skill sets and the current requirements of engineers in each service. This study supports the development of a joint approach to training, equipping and managing all military engineers while ensuring that engineers maintain their capability to perform their primary obligations to their respective service.

Fundamentally, while the Army and Marines require maneuver support in the form of combat engineering, they also have a mission requirement for general engineering. The Navy and the Air Force require trained civil engineers for their mission requirements and have very little need for traditional combat engineering. Here lies the basic difference between military engineering within the services. The understanding of these fundamental and historical mission requirements requires consideration when developing a joint approach to training and equipping the military engineer. Leaders must ensure that each service retains the fundamental engineering support their particular service requires for mission accomplishment today and in future conflicts.

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Introduction

This monograph will demonstrate the strategic historical factors between 1919 and 1991 that contributed to the force structure and mission requirements of the four separate services' engineers. First, this paper will investigate the historical context of the political and strategic situation influencing the force structure of the engineers. Second, it will demonstrate the effects of strategic policies on the military engineer's capabilities during periods of conflict. Finally, this paper will make recommendations based on the findings of this research. The exploration of these factors will focus on six periods of change in the military force structure. The study begins with the interwar period and the periods during and after World War II, followed by changes up to and during the Korean War, then the Vietnam War, and finishes with an examination of the force changes up through the Gulf War in 1991.

United States national strategic policy has had profound effects on the structure of the military over the last 90 years. These policies, focused on the next threat to the United States, have shaped the armed forces and influenced the force structure and capabilities of the military engineers located in each service. While unintended, these changes confused the role of each service's engineers, blurred the mission requirements between combat and general engineering units and resulted in redundancies in skills and tasks. Without a solid engineer leader voice at the decision making level of the military, several engineer force structure issues were created. Maneuver leaders often made incorrect assumptions about engineer structure and support requirements. These uninformed decisions often left the military engineer forces short-handed, ill equipped, and conducting redundant tasks across services when armed conflict ensued.

Changes in strategic policy shaped the expertise of each service's engineers as the services determined their mission requirements. As a general trend, the Army and Marines developed their tactical combat engineering skills, while the Navy and Air Force mission requirements called for general engineering expertise. The historical shaping effects on each

service's engineers also created redundant skills across the military as each service struggled to determine the specific requirements of their engineer force. These issues still affect the current military engineer force structure.

Currently, senior engineer leaders within the United States military are coping with limited assets, increasing requirements, increasing operational deployments, and decreasing budgets. A recent proposal from the Army War College has suggested an expansion of the current Inter-service Training Review Organization (ITRO) program that focuses on unified training for military engineers. The would, in theory, give the same skill sets to all military construction engineers and some combat engineers- thus making an engineer who can execute the general engineer requirements of all four services.¹ Another proposal from the War College has called for a “more joint” approach to training, acquisitions and interpretability that allows for efficiency and eliminates perceived redundancies in engineering specific skills.² While these proposals make sense fiscally, the supporters for these courses of action may not have fully considered the historical context of the development of the various engineer skill sets and the current requirements of engineers in each service. This study supports the development of a joint approach to training, equipping, and managing all military engineers while ensuring that engineers maintain their capability to perform their primary obligations to their respective services.

The US Army Engineer

The United States Army engineer has been a vital fixture in the Army force structure since the Civil War. While the equipment and the policy of war have changed, the basic combat mission to facilitate mobility throughout the battlefield, hinder enemy maneuver, and protect and

¹ Terry Watkins, *Optimizing Joint Engineer Support*. Strategy Research Project, 2007, 2.

² Mark D. Moffatt, *Truly Joint Construction Engineers: The Time is Now*. Strategy Research Project, 2007, 2-4.

sustain those forces has remained the same.³ The engineer force structure and techniques for mission accomplishment have gone through several evolutionary steps over the last 90 years as the nation's focus, doctrine and strategic policy of the time changed.

Interwar Period: Developing a Force for the Next War

The Army engineer experienced a large change in force structure after World War I due to the nationally directed military downsizing of divisions. The driving force of the national policy at the time was an isolationist philosophy and thus, the general purpose of the armed forces was defense of the United States' coastlines. The national defense policy saw no need for a robust, projectable force and called on the military to redesign the force structures of 1918. Planners assumed that, if a war did require deploying forces overseas, all such forces would generate and deploy "overnight," as in World War I.⁴ A core group of active duty officers and enlisted soldiers would train new recruits if war broke out.

The military leaders, in response to this guidance, looked towards their limited experiences in the American Expeditionary Force to France for lessons.⁵ From their observations, they concluded that the division of 28,000 troops used in the open trench warfare of World War I was too large. The belief that the Army needed a smaller, maneuverable force resulted in the reduction of the division to about 19,000 troops with most of the downsizing occurring in the

³ Larry D. Roberts, "The Evolution of the Engineer Force: Part I." *Engineer*, April 2002, 44.

Dr. Larry Roberts has been the Army Engineer Historian for over 30 years. His two articles on the evolution of the engineer force represent a tremendous amount of research that greatly facilitated the writing of the Army Engineer section of this paper.

⁴ Larry E. Hewes, *From Root to McNamara: Army Organization and Administration*. Washington, DC: Government Printing Office, 1975, 50-56.

The theory of "overnight" mobilization was conceived and executed in World War I with a tremendous amount of success in getting large numbers of troops in uniform and into France. The compromise emphasized mass over quality of Soldier as very little training was accomplished before the bulk of the Soldiers saw combat. The experienced core of officers and NCOs from the active service were expected to integrate and train these new recruits quickly and sometimes under fire.

⁵ Roberts, "The Evolution Part I," 45.

service support branches.⁶ The overlying assumption was that open maneuver warfare lessened the requirement for field fortifications and improved road networks, both being essential engineer tasks in World War I.⁷ Thus, Army planners believed that there was no longer a need for large engineer forces within the division and cut the numbers and capabilities of the engineer force. The engineer corps responded by creating two types of non-division engineers, general and specific. The general support units mainly serviced the division through traditional technical engineer tasks such as road construction and maintenance missions. The specialty units consisted of topographic, railway, water supply, bridging, mapping, dump truck, shop, and depot companies.⁸ The division engineers remained roughly the same as the World War I structure, but they downsized from four to two platoons within the companies assigned in each of the two division engineer battalions.⁹

These policy and force structure changes were not the only factors affecting the regiment during this period. In 1935, the Chief of Staff, General Malin Craig, directed a review of the organization and tactics of the Army. General Craig wanted a tactical, maneuverable division that exploited the benefits of armor, airpower and motorized vehicles.¹⁰ General Lesley McNair supported this hypothesis and believed that the way ahead was a maneuverable, armored, yet light force.¹¹ The Army leadership saw a decreased need for engineer support as with greater speed, less dependence on roads and increased reconnaissance, the division of the future would be able to seize key terrain, bridges and roads before the enemy had an opportunity to demolish them.

⁶ Ibid.

⁷ Ibid.

⁸ US War Department. *Engineer Field Manual Vol 1: Engineer Soldier*. (Washington, DC. Washington Printing Press, 1938), 10.

⁹ Ibid., 8.

¹⁰ Roberts, "The Evolution Part I," 45-46.

¹¹ Robert Doughty. *The Evolution of US Army Tactical Doctrine, 1946-1976. Leavenworth Papers, Number 1*. 1979, 21.

Additionally, many believed that with the advent of a more armored force and increased firepower, there was a decreased need for field fortifications and breaching capability. The engineers were in corner where they might be drastically downsized at the cost of capabilities and flexibility for the Army maneuver forces.

The end of the interwar period left the Engineer Corps fighting for its survival and relevance in the new triangular divisions. At one point, a proposal came forward to downsize to a 500-man battalion to support the division. Another proposal cut the engineer division support to a single 175-man company.¹² The engineer leadership lobbied relentlessly and succeeded in keeping some capability in the force in the form of a slightly larger battalion force than the Army originally proposed.¹³ This was a small victory for the engineer corps as it still had a substantial loss in capabilities within the maneuver divisions. A fact that surfaced as America focused on the war in Europe in 1940. The only solace for the engineer corps was that the Army partially recognized the risk of the smaller force in the divisions and allowed for a comparatively robust engineer force structure above division level.¹⁴

Here, the Army allowed for two regimental units within each corps consisting of two engineer battalions of about 600 soldiers each. This provided 2,400 engineers to develop and maintain the Army corps area or to move forward and surge support to fill the gaps in engineer capabilities in the division area.¹⁵ The doctrine of 1941 specified that these units focus on rear area survivability and maintenance, but that the units should be prepared to move forward and support the divisions if required for major combat offensive operations.¹⁶ General McNair

¹² US War Department, *Engineer Manual (1938)*, 9-12.

¹³ Roberts, "The Evolution Part I," 46.

¹⁴ Ibid.

¹⁵ Ibid.

¹⁶ US War Department. *Engineer Manual (1938)*, 1, 4.

apparently believed that this flexibility in engineer support would adequately fill the gap in the organic division engineer capabilities.

The interwar period forced many changes on all services as leaders struggled for funding, relevance and a defined enemy to structure forces against. The Army engineer structure of 1938 found itself smaller and more flexible than the engineers of World War I. The force had many of the same missions, but had fewer people and equipment to complete them. The basic structure had several special units, six types of separate battalions, and three separate general-service regiments.¹⁷ The Army-level engineer units remained to provide the force with mapping, topography, pontoon, depot and maintenance units.¹⁸

Many engineer leaders found the state of the force to be inadequate, but the Chief of Engineers, Major General Julian Schley, quelled their premonitions. In 1941, he addressed the engineer leadership to attempt to alleviate some of their concerns with the inadequate size of the division engineer forces. He argued the advent of heavier and better equipment compensated for the smaller number of engineer troops on the ground. Additionally, he believed the large engineer forces above division would compensate for any void in capability in the division units.¹⁹ The Engineer Corps and the Army leaders failed to realize that the new heavier, more maneuver-centric force had actually increased the need for engineer support. Armored divisions required better roads for support vehicles and stronger bridges for the armor.²⁰ The importance of the Army engineer was about to become a major focal point as the United States prepared for war.

¹⁷ Ibid., 6.

¹⁸ Ibid.

¹⁹ Roberts, "The Evolution Part I," 47.

²⁰ Ibid., 47.

World War II: Changes on the Fly

The error of reducing engineers in the division became all too apparent as the United States entered the European Theater in World War II. The division engineers were not equipped or manned to meet the requirements for breaching, river crossing or road maintenance in the division areas. The Army responded by sending corps engineer units forward to work side-by-side with division units. As it became apparent that the division engineer units could not meet many of the requirements of the division, planners made it “unwritten doctrine to habitually attach the corps engineer battalion to the division” and co-locate that battalion in the division area.²¹ Throughout the beginning of the war, engineers struggled to provide the required support for the division forces and these requirements forced the Army to make organizational changes while at war.

In late 1942, the Army decided to change the engineer regiments into groups as the existing regimental structure did not offer the required flexibility to support the ground forces. By comparison, the group could take on the role of managing several different types of engineers more effectively and shift companies and battalions quickly and easily to units that needed them. Unfortunately, the group structure had two inherent flaws that hindered engineer support. First, the group structure, while theoretically more flexible, did not always afford units the required logistics to be self-sustaining while providing support to forward units. The other drawback, according to many engineer leaders of the time, was that the group did not provide an atmosphere that promoted esprit de corps as individual engineer units seldom had any linkage to the group except through the task organizational chart.²²

The engineer units in World War II continued to perform their missions to the best of their ability while many engineers found themselves performing tasks outside of their specific

²¹ Ibid., 47.

²² Ibid., 47-48.

skill-set. At the end of the war, the engineer corps was in a precarious position as the Army had again manipulated its structure. The elimination of the regiments occurred by the middle of 1944 and their battalions became individually numbered to fit the group organization and tasking concept much like modularity today. Separate battalions were also numbered and transformed into combat battalions while the general service regiments disbanded and their battalions assumed numbers. General-service regiments restructured to become construction units based on the requirements and missions they performed in the Pacific Theater.²³

After World War II: Meeting National Desires

Despite recommendations from senior engineer leaders, the Army senior leadership did not return the regimental units to the engineers. Instead, the Army concluded that it would retain the flexibility of the group structure and would give the division engineer battalions an additional lettered company and more engineers within each company. With this force structure, the battalions could provide one engineer company to each of the regimental combat teams and retain one company for general area support and maintenance.²⁴ While this structure greatly enhanced the capabilities of the division engineer, it was understood that the maneuver division would still require support from the corps engineer combat group for “major combat operations.”²⁵ The non-division combat engineer battalions created from the break-up of the regiments were to provide the primary plug-in for division support. However, these battalions did not have adequate construction equipment and personnel to do much support in the corps or communications area of the battlefield and did not have the mobility of the bridging or assault platoons that the forward

²³ US War Department. *Field Manual 17-45: The Armored Engineer Battalion*. Army Heritage Collection Online. June 14, 1944. <http://ahecwebdds.carlisle.army.mil/awapps/main.jsp?flag=browse&smd=2&awdid=6> (accessed April 1, 2009).

²⁴ William C. Baldwin. *A History of the U.S. Army Engineer Studies Center 1943-1982*. (2001), “Under Chapter II,” <http://140.194.76.129/publications/misc/un19/toc.htm> (accessed March 12, 2009), 33-34.

²⁵ US War Department 1944, *FM 17-45*, 8.

division battalions commanded. Their primary design purpose was to reinforce the division battalions for major operations and movements.²⁶

The division and non-division combat engineer battalions were not the only engineer units that enjoyed some growth and doctrinal reinforcement after the war. The engineer group, both construction and combat, found special purpose in the new task organization of the Army. All non-divisional units found themselves assigned to a numbered army or to the communications zone. Any engineer units now found at corps were there because of a demonstrated need for engineer support in the corps area and resulted in an attachment relationship in the task organization.²⁷ Essentially, engineers were either forward in the division area or held at army level for tasking support as mission requirements dictated.

Doctrine specified, "the engineer group was a versatile command structure that allowed for specific engineer support dependent on the tactical situation."²⁸ One or two group headquarters could be attached to the corps area with several different engineer battalions under their control. This allowed for both construction and combat battalion support in the corps area as well as potential surge support to the division areas.²⁹ Though the flexibility to use both types of battalions was present in the groups, doctrine specified that the engineer groups in the corps area would "usually" consist of two combat groups. Construction unit general utilization was in the field army or communications-zone in direct support relationships to the corps or division units.

While the engineers were struggling with individual force structure, the armed forces in general were struggling with how they should prepare for the next war. The Army organization and administration went through several transitions in the five years between the end of World

²⁶ Roberts, "The Evolution Part I," 47-48.

²⁷ Baldwin, *A History of the U.S. Army Engineer*, 34.

²⁸ US War Department, *Engineer Manual (1938)*, 24.

²⁹ Roberts, "The Evolution Part I," 49.

War II and the start of the Korean War. These changes were unfortunately still in flux when hostilities began in Korea in 1950.³⁰

Korea: An Unprepared Force

The Army Reorganization Act of 1950 had implications on the army forces as they prepared to mobilize for war in Korea. The decision to downsize the army in the period after World War II and the rising threat of the Soviet Union did not give a fair testing ground for the new structure of the engineer force when the United States entered the war.³¹ The poorly manned and equipped engineer forces suffered from the force draw down and the disrepair of equipment left over from World War II. Additionally, Korea was not the top priority of effort for the United States, as forces in Western Europe postured against the Soviet threat.³²

The newly created North Atlantic Treaty Organization had precedence due to the Soviet threat of nuclear weapons and potential for expansion into Western Europe.³³ Many engineer units were not fully manned until the middle of 1951 after the mobilization plan devised could be effected as prescribed in the Reorganization Act. Even after reaching authorized manning levels, the Army learned the same lessons as in World War II; that the organic division engineer units were not sufficient for most division operations.³⁴

It was common for a division commander to request support from the army or corps assets to complete specific operations or improve and maintain limited road networks for logistics and maneuver. Additionally, because of the lack of preparedness for this war and the slow mobilization of required engineer units, the distinction between construction engineers and

³⁰ Hewes, *From Root to McNamara*, 154-208.

³¹ Ibid., 208-212.

³² Roberts, "The Evolution Part I," 49.

³³ Hewes, *Root to McNamara*, 216.

³⁴ Roberts, "The Evolution Part I," 49.

combat engineers became blurred. Most commanders viewed any engineer unit as the type of engineer they required. Construction engineers found themselves constructing defensive belts and survivability positions (tasks associated with combat engineers) around Pusan while combat units found themselves doing construction-type missions at the port and in the rear area.³⁵ The engineer motto, “Essayons” or loosely translated “Let us try”, was taken to the extreme in Korea as engineers did what they could to support the maneuver units with what they had.

A perfect example of the ad hoc force structure required to accomplish engineer tasks in Korea is the creation of the 2d Engineer Special Brigade to support MacArthur’s Inchon invasion in September 1950. The engineer requirements at Inchon were plentiful and difficult. Not only was the route into the port shallow, but the facilities were inadequate to support the large-scale invasion. The organic division units of the Army were insufficient and incapable of meeting the amphibious assault and port requirements of a large-scale invasion into the port of Inchon. MacArthur’s staff determined that an engineer amphibious assault group augmented with a shore regiment, a Marine amphibious division, and three Naval Construction Battalions, would be required for the task. The 2d Engineer Special Brigade had supported amphibious operations during World War II, and thus had a history of successful support to this very type of operation. The engineer brigade headquarters was quickly established, manned, and various engineer units were assigned in order to meet the predicted requirements of the landing and subsequent assault.³⁶ To support this mission, the brigade received the 532d Boat Shore Regiment; three

³⁵ Ibid.

³⁶ Naval Historical Center. “Korean War- The Inchon Invasion, September 1950,” *Department of the Navy – Naval Historical Center*. (February 6, 2001), <http://www.history.navy.mil/photos/events/kowar/50-unof/inchon.htm> (accessed June 30, 2009).

battalions of combat engineers (the 3d, 11th and 14th Combat Engineer Battalions) and elements of the 19th Engineer Group (construction).³⁷

The complexity of the Inchon operation and requirements for cross-service engineer coordination for movement, construction, sustainment and protection were unparalleled since the Normandy invasion on World War II.³⁸

Transforming for an Atomic Battlefield: 1954-1970

The threat of the Soviet Union and nuclear war brought about two different transformation proposals for the Army structure after the Korean War. The Army was departing even further from the human element of combat and relying more on technology to win the fight. This was partly due to the perception that on any future battlefield the United States would be potentially outnumbered and therefore would need to rely more on large casualty causing munitions and superior mobility.³⁹

Pentomic Divisions

In a study initiated by then Army Chief of Staff General Matthew Ridgway, the Army sought to design a force structure that was highly mobile, air transportable and capable of fighting in both an atomic and a non-atomic battlefield. The result was a recommendation to throw out the triangular divisions devised prior to World War II and restructure the force into smaller infantry divisions focused on five battle groups capable of independent action in a “cellular fight.”⁴⁰ The key concept of the Pentomic Division was to maximize mobility on the battlefield to mass and then disperse quickly in the event of atomic weapon use.

³⁷ US Army Corps of Engineers. “U.S. Army Corps of Engineers: A Brief History,” (1997) <http://www.usace.army.mil/history/pages/brief/index.html> (accessed March 24, 2009).

³⁸ Roberts, “The Evolution, Part 1” 49

³⁹ Doughty, *Evolution of Doctrine*, 16.

⁴⁰ Ibid., 18.

The result for the engineer battalion within this Pentomic division was one of restructuring and limited growth. The battalion went from four to five companies with two platoons each, and one bridge platoon maintained at the battalion headquarters.⁴¹ In addition to the engineer battalion, each battle group had one platoon of engineers for limited pioneer work on the battlefield. These battle group platoons did not have any heavy engineer equipment and were expected to do most of their expedient road repair and trail, ford, and culvert construction by hand.⁴²

The need for engineer support throughout the larger, deeper, and potentially more damaged atomic battlefield also afforded the growth of one additional combat engineer group consisting of three battalions per a corps. This growth resulted in planned engineer strength of nine available battalions at the corps for tasking throughout the battlefield based on the tactical situation. Combat engineering remained the focus to support the maneuver force movement throughout the nuclear battlefield.⁴³

The Army began to reorganize and test the division from 1956 through 1959. Despite opposition to the Pentomic concept and structure, the reorganization and testing of the Army divisions went forward through 1959. The original concept called for a five-year plan for testing and evaluation, culminating with a short period of appropriate adjustments. The results of the Pentomic study demonstrated a need for more mobility, autonomy and firepower.⁴⁴

ROAD Concept

General Wesley C. Clark, one of the original members of the Pentomic design committee, fully understood the shortfalls of the Pentomic concept and ordered a new study that

⁴¹ US Army, *Engineer Field Manual: Engineer Operations*. 1953

⁴² Dr. Larry Roberts, "The Evolution of the Engineer Force: Part 2." *Engineer*, June 2002, 41.

⁴³ Ibid.

⁴⁴ Ibid., 42.

would look at fixing the issues with the Pentomic force structure. The “Modern Mobile Army I” (MOMAR I) report began in 1959 with the mandate to find the right transition for the future force starting in 1965. General Clark envisioned a force with increased firepower, mobility, and capabilities allowing individual battalions to function independently for short periods while operating and coping with a nuclear attack. He wanted enough flexibility in the structure to allow for employment of these forces in atomic or non-atomic battlefields. Finally, he wanted forces that were survivable and capable of integrating with air assets to mass on enemy forces quickly and efficiently.⁴⁵

With this guidance, the Command and General Staff College began refining the organization and developing the future design of the force. The initial ideas from the 1960 Leavenworth study group resulted in a “building block” concept that allowed for greater flexibility in the task organization and employment of the divisions. The group recommended building maneuver divisions tailored for specific terrain and missions while concurrently holding one to two air-mobile brigades in reserve for rapid employment or reinforcement of heavier units.

The CGSC task force executed several exercises with the new requirements and designs and concluded a requirement for only two different types of battalions, one for dismounted operations and one for mechanized operations. Essentially, the force structure in MOMAR assumed that the Army would only fight large-scale land combat like that expected in Western Europe. Fortunately, some senior leaders envisioned other types of combat operations that did not necessarily require the proposed large, armored force. With that insight, the Department of the Army drafted a memo that stated MOMAR, “does not provide the simplicity, homogeneity, versatility, and flexibility required by the Army.”⁴⁶ The Army saw utility in MOMAR as a

⁴⁵ The following three paragraphs are primarily based on Doughty, *Evolution of Doctrine*, 18-21.

⁴⁶ Department of the Army, “Reorganization of the Infantry and Armored Divisions and Creation of the Mechanized Divisions.” para 13-A-3. Memorandum acquired through CARL reserves.

starting point; however, the large heavy divisions would be too cumbersome in many of the potential environments that forces may deploy to in the future.

The MOMAR I study concluded relatively quickly and allowed the Army time to adjust goals before the proposed implementation date in 1965. The recommendations from the CGSC study group became guidelines to aid in the transformation. They specified a more versatile force, capable of operating in varying terrains and environments and able to execute missions on atomic and non-atomic battlefields. Additionally, they specified that the force should focus on battle groups and avoid returning to the traditional battalion. The battle groups centered on the infantry, mechanized, and armored division concepts in order to provide capabilities across the forecasted spectrum of warfare.⁴⁷

The result of the study was a report entitled the “Reorganization Objectives Army Division (ROAD) 1965.” The simplicity of ROAD was that it called for a basic structure of organic units under a central division headquarters. The initial preponderance of combat battalion type determined the designation of the division as infantry, mechanized, or armored. For example, an infantry division could have three brigades with two brigades consisting of infantry and one brigade consisting of armor. Additional organic units within the initial division task organization included signal, and supply battalions with the option to add or delete combat battalions based on mission requirements. This gave the division a large amount of flexibility, as the combat force was customizable for specific environments and threats.

The effect of ROAD on the engineer force was one of growth. Since the basic premise of ROAD was to have a division consisting of three maneuver brigades, it almost looked like the 1948 triangular division.⁴⁸ The difference for the engineer force centered on the reduction to three lettered companies in a battalion and the addition of a bridge company. The technological

⁴⁷ This section primarily based on Doughty, *Evolution of Doctrine*, 18-22.

⁴⁸ Roberts, “The Evolution Part II,” 42.

addition of the Combat Engineer Vehicle (CEV) eliminated the need for an assault platoon in the engineer Headquarters and the advances in armor and mobility required that the engineers provide more bridging assets to the maneuver force.⁴⁹

At the corps level, ROAD called for the deletion of an engineer group bringing the total to two.⁵⁰ Within each group, the engineer force became customizable through the addition of combat or construction engineer battalions. There was growth in the battalions with the addition of a fourth platoon to each engineer company. The corps lost one of the three engineer battalions it had gained in the MOMAR I restructuring, but the number of companies found at the corps level increased due to the addition of a brigade combat headquarters.⁵¹ This engineer headquarters allowed for engineer specific planning and management in major theaters of operation. Overall, ROAD gave the engineer corps more forces for diverse operational support in the corps and division areas and a better method of command and synchronization of engineer effort at the corps and army level.⁵² Unfortunately, construction engineers fell behind doctrinally as they remained under echelons above corps control in the communication zone.

Vietnam

By 1965, the ROAD division had become a reality in design and application. The new division offered enough flexibility with its three maneuver brigades to satisfy most mission requirements. However, because of the non-conventional threat, the harsh jungle terrain, and the lack of infrastructure to move heavy forces, the Army never deployed an armored division with

⁴⁹ Ibid., 41-42.

⁵⁰ Doughty, *Evolution of Doctrine*, 22.

⁵¹ Department of the Army, "FM 5-142: Non-Division Engineer Units." *Army Heritage Collection Online*. (August 21, 1967), 8-9. <http://ahecwebdds.carlisle.army.mil/awapps/main.jsp?flag=browse&smd=1&awdid=4> (accessed April 1, 2009).

⁵² Roberts, "The Evolution Part II," 42.

its tanks to Vietnam.⁵³ Instead, the preponderance of deploying forces consisted of light and mechanized divisions and a not so balanced mix of construction and combat engineer battalions.⁵⁴ The results of this action were a partial test of the structure of the ROAD division, but the full applicability of the force was never tested completely in Vietnam as this was not the environment or war that the force was designed to fight.⁵⁵

The general nature of the war in Vietnam did not afford the practical use of the doctrine prescribed under ROAD. However, the increase in helicopter technology and availability of airframes in the ROAD division inspired new tactics for mobility in the jungle.⁵⁶ The need for combat engineers in major mobility operations was minimal and thus most engineer units found employment doing construction for bases and rear area lines of communications, or fighting as infantry.⁵⁷

Another major obstacle to fighting doctrinally was the fact that over half of the Army's engineer forces were in the Reserves and the National Guard and the senior leadership refused to do a partial call-up of forces to fill the gap in available engineer forces. The lack of support to correctly man the engineer requirements in Vietnam forced misapplication of engineer forces.⁵⁸ Forward deployed and rear area units found themselves in need of massive engineer support for base and road infrastructure support as well as combat support for counter-obstacle and demining operations. Engineer units performed both types of engineering to meet the requirements of the

⁵³ Doughty, *Evolution of Doctrine*, 25.

⁵⁴ Robert, "The Evolution Part II," 42.

⁵⁵ Ibid.

⁵⁶ Doughty, "Evolution of Doctrine," 26-27.

⁵⁷ Roberts, "The Evolution Part II," 42.

⁵⁸ Robert Plogger. *Army Engineers 1965-1970* (Washington DC, Department of the Army, 1974), 20-24.

combat commanders. The robust need for engineers of all skills across the theater forced the development of a new tactic to meet the needs of the Army.⁵⁹

Major General Robert Ploger, the commander of U.S. Army Engineer Command-Vietnam (USECV), struggled with the initial lack of planning and forethought by Army planners. Because there was no understanding of the true number of deploying combat battalions and because a true campaign design including a general tactical concept and logistical support concept had yet to be determined, there was little to use for estimating the required engineer support.⁶⁰ The competing strategic goal to maintain a deterrent force in Europe left only active duty CONUS units available to deploy. The result was engineer forces deploying to Vietnam independent of their mission type and specialties. This had unique implications on the force structure as MG Ploger split the country into several engineer areas assigned to engineer groups. Units within that area would draw additional engineer support from the engineer group assigned to that area. Essentially, the design and application of non-division engineer units did not fit the doctrinal mold of ROAD as all battalions served in direct or general support relationships to the maneuver brigades.⁶¹ The attachment of a combat engineer battalion to a division was not always practical as the only available engineer battalion may have been construction. Additionally, the use of helicopters for unit mobility negated the need for a combat engineer battalion in certain cases. The heavy equipment of the mechanized engineer battalions found less use for the forward maneuver brigades and replaced by air-mobile dozers and engineer equipment from the light and airmobile engineer battalions replaced such equipment to support combat and general engineering tasks in the forward area.⁶²

⁵⁹ Roberts, "The Evolution Part II," 43.

⁶⁰ Ploger, *Army Engineers*, 2-3.

⁶¹ Ibid., 1-5, 215

⁶² Roberts, "The Evolution Part II," 44.

Air-Land Doctrine: 1975-1990

Vietnam had partially validated the ROAD construct in the light and mechanized divisions, but it did not afford a full exploration of the heavy division. After Vietnam, the focus for the next war turned back to Western Europe as leaders began to study the implications of the conventional tank battles that had recently occurred in the Yom Kippur War in 1973. Senior leaders were concerned over the performance of the M-60 tank against the Soviet T-72's and many believed that the Army had not modernized its forces to keep on par with the Soviets. The concerns over the development and eventual incorporation of new technologies into systems and doctrine became a major focal point from 1973 through 1975.⁶³ The resulting study commissioned through the Training and Doctrine Command (TRADOC) explored the addition of new equipment that improved the mobility, maneuverability, firepower and logistics capabilities within the heavy division.⁶⁴

The engineer force structure again was targeted to help lower the number of total forces organic to the division and meet General Abrams' requirement to eliminate all active forces that did not provide direct support to the war fighter.⁶⁵ While maintaining the basic combat engineer battalion of four lettered companies, the new structure removed the bridge company from the division and placed it in the corps engineer brigade. Many engineer leaders found this decision questionable as the heavier force would require bridging assets to remain mobile and maneuverable on the battlefield.⁶⁶ Additionally, the Army began looking for non-combat engineer forces that could shift into the reserves. The engineer leadership responded to this potential threat by renaming the construction battalions as combat heavy battalions. It also gave

⁶³ Doughty, *Evolution of Army Doctrine*, 41.

⁶⁴ Roberts, "The Evolution Part II," 44.

⁶⁵ Doughty, *Evolution of Army Doctrine*, 42.

⁶⁶ Roberts, "The Evolution Part II," 44.

some reductions to the Army by shifting a large portion of the engineers at corps and echelons above corps to the reserve components. Aside from this move of the higher support engineers to the Reserves, the engineer force and its mission remained the same. The main difference lay in the availability and employment of personnel and new equipment.

The Army based the reorganization of the force on still developing technologies. This caused capability gaps in the force as the equipment being replaced by the yet to be fielded equipment was obsolete, worn out, or simply did not fill the new requirement of the gaining technology.⁶⁷ The M9 Armored Combat Earthmover (ACE) is an example of the Army forcing transition prior to equipment availability. The ACE design filled a perceived gap in the combat battalion for survivable obstacle reduction and forward battle position construction previously done by open cab, light dozers or construction units with equipment that offered little protection to the operator. The transition to the new force began in 1984, but the ACE did not arrive in units until 1990.

The focus on the heavy division waned in 1979 as the new commander of TRADOC, General Donn Starry, determined that the Army would restructure the light divisions to be faster, smaller, and air deployable in C141 “Starlifters.” This resulted in downsizing of divisions to about 14,000 troops and shrinking the engineer battalion to about 400 from 600 engineers. The result was the elimination of most of the heavy equipment within the light combat engineer battalions, except for a few ACEs and Small Excavation Equipment (SEE). General Starry’s focus was on deployability to theater and not on mobility and maneuverability in theater.

Light division unit design was around a 10,000-troop construct. This resulted in a very small engineer battalion of a little more than 300 engineers with four lettered companies of 63

⁶⁷ This section primarily references Roberts, “The Evolution Part II,” 45.

men each.⁶⁸ Limited numbers of heavy engineer equipment were in the Engineer Headquarters Company for tasking to other units to meet specific mission requirements. The Army of Excellence program also proposed downsizing in the airborne, airmobile, and motorized divisions.”⁶⁹ These reductions also resulted in small engineer battalions with smaller companies justified by the assumption that lost manpower and traditional equipment could be countered through the application of new technologies and equipment.

The Army had planned the restructuring of the divisions based on new technologies and had failed to budget them properly into the acquisition process. The result was a dramatically smaller, deployable force that did not emerge to standard due to a lack of funding, available technologies, and support.⁷⁰

The Army experienced the end of the cold war in 1989, and with it, the lack of a defined enemy against which to model forces. The unforeseen fall of America’s greatest threat left the Army with the armored, mechanized, light and airborne force structures devised between 1975 and 1986. This mix of forces deployed to the Gulf War beginning in August of 1990 and fought the Iraqi forces in the open maneuver space of Kuwait and Iraq in 1991.

While division units of the Army were essentially structured for this type of conventional war, engineer units continued to struggle with meeting the requirements of the heavy and mechanized divisions with the single authorized battalion. Over the course of four years, engineer leaders devised a new concept that allowed for an engineer brigade headquarters with three

⁶⁸ Department of the Army. *FM 5-6: Engineer Organization and Manning* (Washington DC, 1975), 4-8

⁶⁹ Roberts, “The Evolution Part II,” 45.

⁷⁰ *Ibid.*, 45

engineer battalions per armored or mechanized division. The E-Force concept was informally tested and eventually changed in name to the Engineer Force Initiative (EFI).⁷¹

Several exercises at the National Training Center tested the new organization prior to the war, but it never received formal acceptance in doctrine up to the start of the Gulf War. Of the five divisions deployed to the Gulf, four went with the EFI task organization.⁷² The manning of these units presented a unique challenge in that forces had to be taken from other engineer elements, usually corps engineer brigades. The shortness of the war negated the ad hoc command structures inherently present when combining several different types of battalions under an unfamiliar command during real-world operation.⁷³ Many leaders believed that had the war gone on longer, command and control, resourcing and supply would have become major issues in the newly formed engineer brigades.

However, due to the success of the EFI during the Gulf War, the Army ordered that all remaining divisions restructure to match the EFI engineer brigade construct.⁷⁴ Many perceived the order to move to the EFI as a major success for the Engineer corps as it was able to design an engineer force without disruption from the maneuver commanders. This allowed engineers to make a more suitable package to support the maneuver division than most commanders would care to recognize. Unfortunately, this engineer success was short-lived as the Army found it difficult to fund and equip any restructuring while downsizing during the Clinton Administration.

⁷¹ Bruce Porter. *A Revolution in Military Engineering* (April 7, 1997), 4. <http://stinet.dtic.mil/dticrev/PDFs/ADA326682.pdf> (accessed June 10, 2009)

⁷² Roberts, "The Evolution Part II," 46.

⁷³ Ibid.

⁷⁴ Ibid.

Army Engineers: Conclusion

The responsibilities of the engineer force have remained fairly consistent for the last 90 years.⁷⁵ However, engineer leaders have constantly struggled to structure the force to meet requirements as Army leaders from each era, determined to make their mark on history, have redefined the requirements of military forces. The foundational mission of the Army engineer has remained the same throughout these periods to provide mobility, counter-mobility and survivability to the maneuver forces while simultaneously constructing and maintaining lines of communications to support the forward units. The major changes to the engineer force were not based on the mission of the army engineer, but pivoted in response to the national strategic policy and the perceived threats to the United States at those times.

The Marine Engineer

From its creation in 1776 to the period between the world wars, the primary mission of the Marine Corps was to secure and maintain US ships and ports. The Marines performed this mission with distinction all over the world while fighting limited engagements as infantry abroad and at home such as in the Philippines and during the Spanish-American War.⁷⁶ This infantry role was further expanded during World War I as the 4th Brigade fought alongside the Army on the front lines in France. The Marine Corps emerged from World War I as a proven ground force, but it still struggled for relevance in the United States military against the defined missions of the Army and the Navy.

The political and strategic history of the Marine Corps parallels the Army as they were competing for scarce funding. Additionally, the mission of the Marine engineers focused on enhancing mobility, counter-mobility and survivability of the Marine divisions. Thus, the Marine

⁷⁵ Roberts, "The Evolution Part I," 41.

⁷⁶ Edwin Simmons, *The United States Marines: 1775-1975* (Viking Press, New York, 1974), 58-

engineer shares many of the same capabilities of his Army counterparts, but the origins of Marine doctrine were very different from the Army based on the uncertain role of the Marines after World War I.

The Marines' fundamental requirements from 1941 through 1945 were to provide mobility, counter-mobility and survivability to the Marines as they assaulted Japanese held islands in the Pacific. The underpinning difference between the Army and Marine engineers was the mission of the Marine Corps at the onset of the war to establish hasty landing sites and secure forward bases for the Navy. Besides a different mission requirement than the Army, the Marine engineer had an almost pure combat focus with technical construction primarily executed by the Naval Construction Battalions (NCB). Due to the unique relationship and proximity to the Navy Seabees, the Marine engineer focused on mobility while the Seabees filled the survivability and sustainment functions with their construction expertise. While Marine engineers were expected to maintain general engineering capabilities, they intentionally stayed away from the more technical engineering jobs because there was no need to spend time on this expertise with the Seabees nearby.⁷⁷

These facts set the foundation for how the Marines would develop their engineers into a mobility-focused combat engineer force that supported the newfound Marine missions in the Pacific Theater of World War II. The initial slow development of the Marine engineer was based on the murky existence and mission of the Marines during the interwar period as their leaders fought Naval and political leaders for the relevance of the Marines.

Interwar Period: 1919-1941

While the interwar period found the Marines deployed throughout the world in places such as the Caribbean, Cuba, Haiti, and the Dominican Republic, they too found themselves

⁷⁷ Prefer, *Uncertain Mission*, 57.

looking for purpose and survival as a military force in the political isolationist environment of the United States.⁷⁸ Engineers were all but non-existent in the Marine regiments of this time as the primary mission still was that of half-sailor, half-soldier and did not require combat or construction engineer expertise.⁷⁹ That changed when the Marine Corps was able to create and validate a new mission requirement based on the 1921 amphibious assault proposal, “Operation Plan 712.” Developed by Lieutenant Colonel Earl H. Ellis, Plan 712 expanded on plan Orange by filling the requirement for forward operating bases in Micronesia “to wage war in Japanese waters” if Japan attacked the United States.⁸⁰ With OPLAN 712, the Marines, with their historical ties to sea mobility and recent experiences abroad, began building the doctrine required for amphibious warfare that developed through the 1920’s and 1930’s.⁸¹ The 1939 result was the creation of the Fleet Marine Force (FMF) and a requirement for combat engineers to breach beach obstacles and establish holding and staging areas for supplies and Marine ground and air forces as they prepared to move inland.⁸²

The FMFs stated mission was to conduct landing operations and establish a forward operating base in order to support future naval and land operations.⁸³ This basic concept led to the natural development of a joint force approach that included naval gunfire, naval and marine air, and marine landing forces. As the new Marine doctrine developed and underwent experiments during the late 1930’s, it became apparent that the Marines on the beach would require specialty forces to breach enemy mines and obstacles as well as provide mobility inland to pursue an

⁷⁸ George Forty, *US Marine Corps Handbook 1941-1945* (Sutton Publishing, 2006), i.

⁷⁹ Simmons, *US Marines*, 125.

⁸⁰ Ibid.

⁸¹ Forty, *Marine Corps Handbook*, 2-3.

⁸² Simmons, *US Marines*, 125-126.

⁸³ Forty, *Marine Corps Handbook*, 4.

enemy.⁸⁴ The addition of an engineer regiment to the basic Marine division was a natural step to meet the mobility needs of the Marines. The 2,513-man engineer regiment consisted of a headquarters and service company, an engineer battalion with three combat engineer companies, a pioneer battalion with three companies and an attached naval construction battalion.⁸⁵

The addition of these engineers provided the Marine division an improved capability that allowed them not only to breach obstacles on a fortified beach, but to establish initial ports and control areas for follow-on land forces, such as the Army, to muster from. The development of the amphibious doctrine became essential as the United States started preparing for war. The 18,059 active duty Marines of 1939 quickly found their numbers double as President Roosevelt began to mobilize the Marine reserves when Germany attacked into France through Poland.⁸⁶

The survival and changes in the Marines during the interwar period were based on strategic isolationism with a capability that called for vessels and ports in forward bases throughout the world to secure US shipping interests. The national threats of the time, primarily Japan in the Pacific, enabled the Marines to focus their skills as sailor-soldiers into an amphibious doctrine that could take the fight to the enemy and curtail threats to the US coasts. The addition of engineers to the FMF structure provided the ground force Marines with the capability to breach through complex coastal defenses and secure forward ports for the Navy. Without the forethought of several key Marine leaders in the twenties and thirties to develop amphibious warfare, the US would have found itself ill prepared to fight a war against Japan in the Pacific in 1941.

⁸⁴ Ibid., 4-6.

⁸⁵ Ibid., 63.

⁸⁶ Simmons, *US Marines*, 138-139.

World War II: Testing Amphibious Doctrine in the Pacific

Japan attacked Pearl Harbor on December 7, 1941. The next day, President Roosevelt and Congress, declared war on Japan. As the only force capable and trained in amphibious warfare, the Marine's had a new doctrine, "Landing Operations Doctrine, US Navy, 1938," that found practical application in the Pacific Ocean.⁸⁷ The Marines began mobilization and organized into two divisions that deployed forward into the South Pacific to begin what Joseph McNarney, the deputy Army Chief of Staff, foresaw as "a year-long series of landing operations from shipboard to small islands with relatively small forces."⁸⁸ The Marine Corps alone had been training for a mission that it was about to test at Guadalcanal with an unproven engineer battalion force structure.

The Marine division landing on Guadalcanal at Lunga Point on August 7, 1942 was relatively easy for the Marines despite the fact that the engineers had none of their heavy equipment. Japanese defenses were ill prepared and there were few combat enemy soldiers on the island at the time of the landing. The Marine engineer battalion found little employment except in destroying small bunkers and improving the landing area to bring supplies and Marines ashore to seize Henderson Airfield. Despite not having their heavy equipment ashore, the importance of having both combat and construction engineer capabilities within the Marine regiment became apparent as the Marines required the construction assets in the pioneer battalion to improve the captured Japanese defensive line, create survivability positions to withstand the Japanese counterattacks, and repair and extend the airfield.⁸⁹

⁸⁷ Ibid., 142-144.

⁸⁸ Ibid., 144.

⁸⁹ Ralph W. Donnelly, *A Brief History of the U.S. Marine Engineers* (Historical Branch Headquarters, US Marine Corps, Quantico, VA, 1968), 7.

Donnelly's work provided a concise history of the engineer structure and missions within the Marine Corps. His research represents the only dedicated work to the historical study of the Marine Engineer that this author found.

Combat engineers demonstrated their versatility and value to the Marines as they not only enhanced mobility through the jungle for the Marine battalions, but fought as infantry when required. One example was the 1st Engineer Battalion and Headquarters Company's successful defense against a Japanese attack on the airfield on the morning of 14 September.⁹⁰ The pioneer battalion demonstrated its utility in clearing paths for patrols around the airfield, fortifying artillery and crew-served weapon positions and maintaining the airfield. The Marine engineers solidified their place within the division throughout Guadalcanal, but remained primarily in the role of a combat service support element.

The remainder of World War II facilitated the refinement of beach landing doctrine as the Marines continually attacked Japanese held islands. The refinements to amphibious doctrine were soon picked up by the recently created Army amphibious units and tested in joint Army-Marine island operations in the Pacific in 1943.⁹¹ Additionally, the utility of the engineer battalion and the pioneer battalion in the Marine Regiment was tested and proven on every island taken by the Marines throughout the war.

By 1942, the Marine Corps had elected to build up the size of the engineer force, but following the Army's example, split the engineering tasks into two main areas: tactical engineering and general engineering. Within the division, tactical engineering tasks were assigned to the engineer battalion and general engineering to the more equipment oriented pioneer battalion.⁹² Although the new term "tactical engineering" appeared, there was no new combat-oriented doctrine, equipment, training, or organization specifically developed. The engineers still operated with commercial construction equipment, slightly modified to meet military needs. In manning and equipment, the pioneer battalion was quite similar to the engineer

⁹⁰ Simmons, *US Marines*, 152-154.

⁹¹ Ibid., 162.

⁹² Donnelly, *Brief History of the Marine Engineer*, 9.

battalion. Pioneers normally landed with landing teams, on D-day, to begin establishing supply dumps in support of the assault units. During the initial landings, their duties went outside engineer tasks as they were stretcher-bearers, runners, scouts, or whatever required by the landing force commander.⁹³

The Marine engineer and pioneer battalions moved from the Marine division to the newly created amphibious corps in 1944 in order to provide flexible support to the Marine divisions. This change resulted in the loss of the NCB as it returned to the control of the Navy. The engineer regiment retained the engineer and pioneer battalions and attempted to compensate for the loss of the NCB capabilities to the engineer regiment with a slight increase in end-strength. However, the larger companies did not provide the same level of support or required construction expertise of the NCB.⁹⁴

The end of World War II left the Marines with a much larger and proven force than had entered the war. Instead of just two brigades of Marines, there were now two amphibious corps consisting of six divisions with eighteen infantry regiments, thirty-six artillery battalions, and two engineer regiments consisting of twelve engineer battalions.⁹⁵ The growth of the Marine end-strength, the refinement of amphibious assault doctrine, and their specialized mission gave the Marine leadership a strong argument for the survival of the Marines.

Post War: 1946-1950

Post war American politics influenced the Marines in ways that the Marines could not entirely predict. While the Marines occupied Japan and China, Congress began to set the

⁹³ George Forty, *US Marine Corps Handbook: 1941-1945* (Sutton Publishing, United Kingdom, 2006), 47-53

⁹⁴ Donnelly, *Brief History of the Marine Engineer*, 9-10.

⁹⁵ Forty, *Marine Handbook*, 45

peacetime strength for the military and the debate over the relevance of the Marines resurfaced.⁹⁶ The Army, Navy and Marines were in a fight for resources, money, and relevance in the post war world of the atomic age. As with the Army engineers, the Marine engineers were on the chopping block as the Marine Corps struggled to find a mission in the Atomic Age.

Congress determined that the Marines would downsize from their peak wartime strength of 485,053 to 107,000.⁹⁷ This number consisted of two Fleet Marine Forces (FMF) each consisting of one Marine division and one air wing, with all supporting elements, such as engineers and artillery. Additional duties for the Marines during peacetime returned to their roots of ship and port security with the addition of embassy security abroad.⁹⁸

Meanwhile, the Marine leadership found itself caught in the same trap as the other services as President Truman mandated that there would be a unification of military training and efforts to reduce redundancy and waste.⁹⁹ President Truman perceived the Marines to be an army for the Navy that had no practicality, as a beach landing on the modern atomic battlefield seemed improbable.¹⁰⁰ Much like the fight the Marines experienced in the interwar period, the Marines again had to prove their relevance in an atomic age.

Through a tremendous effort and support from the Navy, the Marine leadership was able to lobby Congress to maintain the Marine Corps and its projectable capabilities in the form of the FMF. The Marines refined the amphibious doctrine to compensate for the atomic battlefield by incorporating two key changes. First, they conceded that a concentrated front attacking a single point on a beach involved too much risk. They compensated by developing an attack that only

⁹⁶ Simmons, *US Marines*, 225.

⁹⁷ Ibid.

⁹⁸ Ibid., 226.

⁹⁹ Prefer, *Uncertain Mission*, 172.

¹⁰⁰ Ibid., 172-173.

concentrated at the last possible moment when beach landings would be required.¹⁰¹ The second innovation involved skipping the beach and establishing a secure area further inland. This bold approach involved the newly introduced cargo helicopter as the delivery apparatus for Marine infantry and light artillery. The helicopter offered severally advantages to the Marines in the form of speed, maneuverability and flexibility to disperse on approach and consolidate forces when required. This new doctrine still required the aid of combat engineers to enhance mobility, counter-mobility, and survivability for the ground forces once they landed despite the fact the view of the Marine engineer mission remained combat service support.¹⁰²

The signing of the National Security Act of 1947 resulted in the Marines maintaining two under-strength divisions of deployable Marines in the form of FMFs.¹⁰³ It also specified that the Marines would maintain internal air, artillery, and support assets to be self-sustaining on the battlefield. The impact on the engineer force structure was minimal despite the drawdown of forces. Unlike the Army, the Marines eliminated entire divisions, but maintained their core capabilities within the FMF. The engineer battalion remained under the control of the regiment and looked very similar to the engineer battalion of World War II with an end strength of about 680 engineers.¹⁰⁴ Additionally, in 1947, the pioneer battalion name changed to "Shore Party Battalion" to reflect its mission more clearly. The Navy agreed to aid the pioneer battalion's engineering effort with the Navy construction battalion, now affectionately known as Seabees.

¹⁰¹ Larry W. Berquist, "Combat Engineer Battalion: A Time for Change" *Command and Staff College Report* (Headquarters, US Marine Corps, Quantico, VA, 1990), 2-4.

¹⁰² Donnelly, *Brief History of Marine Engineer*, 10-11.

¹⁰³ Ibid., 9.

¹⁰⁴ The following section primarily references Donnelly, *Brief History of Marine Engineer*, 8-10.

Korea: 1950-1953

The engineer battalion in the Marine regiment entered the Korean War hastily as General MacArthur requested the service of the Marines as soon as possible. The downsizing and restructuring the Army had imposed on its engineer force structure was not as restrictive to the Marines, but they had been poorly manned and equipped over the last five years as the bigger Army restructured and consumed resources and manpower. By maintaining the proven engineer support concept of World War II, the Marine engineer entered combat on the Korean Peninsula ready to meet the combat needs of the FMF. Marine engineers again proved their worth to the Marine forces, first as the 1st Engineer Battalion, 1st Marine Brigade, plugged the North Korean penetration at Pusan. Again, as MacArthur orchestrated the audacious landing at Inchon Marine and Army engineers supported the amphibious assault and subsequent build-up of supplies and forces.¹⁰⁵ The only lacking engineer capability that Marine leaders noted throughout the war was in construction expertise and equipment. Marine engineer battalions primarily performed frontline route clearance and demolition support to the infantry while the shore party battalion remained at the ports. Despite this fact, the Marine combat engineers performed construction tasks when asked. One example from March 1953 had the Marine engineers build a prisoner exchange reception center in 36 hours. Tenacious engineers using hand tools completed the task.¹⁰⁶

Marine construction expertise primarily came in the form of combat heavy Army engineers and Seabees. The Seabees augmented the Marine Shore Party with additional heavy equipment and aided the engineer battalion with construction of field fortifications, defenses, and lines of communication maintenance throughout the war. The Marine engineers considered

¹⁰⁵ Philip Pierce and Frank Hough, *The Compact History of the United States Marine Corps* (Hawthorn Books, New York, 1964), 306-308.

¹⁰⁶ Donnelly, *Brief History of Marine Engineers*, 10

themselves more as infantry and were treated as such by the Marine commanders. Engineers often fought as an additional battalion of infantry throughout the Korean War, despite their other primary support mission of general engineering.¹⁰⁷ While construction, water purification, and other general engineering remained a necessity for a force at war, the needs of the Marines were more combat focused and thus relied on the mobility, counter-mobility, and survivability of the tactical engineers.

The Marine engineer appeared to be better prepared for the war than his Army counterparts. Marine engineer force structure had remained essentially the same despite the fight before the war to retain the Marine engineers. However, due to the political and strategic goals of the United States in the coming years, the Marines would reevaluate the engineer role and mission within the Fleet Marine Force and Marine-Air Ground Task Force (MAGTF).

Post War: 1954-1965

The Marines had grown almost twice the size they had achieved at the end of World War II and had again proven the need to maintain a mobile and quick striking force as it had answered MacArthur's request quickly.¹⁰⁸ While a drawdown in size was inevitable, the Marines went to work structuring the Corps to meet the needs of the next war. The organization it established in 1955 looks almost identical to the Marine Expeditionary Force (MEF) it uses today. Two divisions consisting of a Ground Combat Element (GCE), an Aviation Combat Element (ACE), and a Combat Service Support Element (CSSE) with two types of engineers, combat support and engineer support; a separate engineer battalion supported the air wing.¹⁰⁹

¹⁰⁷ Ibid.

¹⁰⁸ Pierce and Hough, *Compact History of Marine Corps*, 305.

¹⁰⁹ US Army Engineer School, Joint Engineer Officers Course Alumni, *Marine Corps Engineer Capabilities*, "Under Module A, Lesson 2.1," <https://www.bb.wood.army.mil>, (accessed 15 September, 2009)

Landing Force Manual 13-Engineers was the result of the restructuring of the Marines. Dated April 11, 1957, the manual made the important distinction between the two types of engineering support in the Marines. It stated that the FMF engineers were responsible for temporary construction and that the naval construction battalions would provide semi-permanent and permanent structures.¹¹⁰ The construction tasks fell primarily on the engineer support battalion in the CSSE, though the division tactical engineer battalion provided engineer support to amphibious operations as listed below.¹¹¹

Obstacle breaching and clearance

Beach preparation (includes surveying, marking, and installing boat guidance markings)

Demolitions

Construction, repair, and maintenance of routes of communications

Engineer reconnaissance

Water Supply

Installation of mine, booby traps, and obstacles

Employment as infantrymen

Technical assistance in handling and storage of bulk fuel dispensing systems

The engineer battalion remained in the CSSE and provided general engineering and combat type support as needed. Despite the need for combat engineers, the Marine leadership maintained that the function of the military engineer was to provide general engineer support and facilitate the movement and storage of supplies to forward deployed Marine forces.¹¹² The resulting division engineer organization had a headquarters company, a service company, and

¹¹⁰ Donnelly, *Brief History of Marine Engineer*, 10.

¹¹¹ Ibid., 10-11.

¹¹² Donnelly, *Brief History of Marine Engineer*, 11-12.

four engineer companies with the latter tasked to provide combat and general engineering support.

World War II and Korea demonstrated a requirement for engineer support to the FMF team. Planners expected that an air-ground task force of division wing size would require one force engineer battalion, one bridge company, and one topographic company.¹¹³ The lessons learned from smaller Marine interventions in the world from 1956-1963 resulted in further refinement of the engineer force structure in the FMF. Marine doctrine now specified that the mission assigned to the FMF engineer

is to increase the combat effectiveness of the landing forces. This is done by providing essential engineer support to enable landing forces to break hostile beach defenses and proceed inland. Units are organized to provide combat engineer support of a pioneer nature to assault units and to provide combat engineer support to the entire landing force.¹¹⁴

The new Landing Manual also specified that the engineers support the landing force operations, establish and maintain advanced landing fields, and establish and maintain temporary camps. The organic engineer battalions provided all these tasks. These units could be expanded on during landings using the force engineer units comprised of the topographic, bridging company, and bulk fuel company.¹¹⁵

Additional engineer units beyond the ground component were located in the air wing. These engineers included a utilities unit that could do electrical work, provide refrigeration, and process water and an equipment unit. The equipment unit could repair and maintain airfields and provide general engineer support to the air wing.

¹¹³ Ibid., 11.

¹¹⁴ US Marine Corps, *FMF Manual 4-4: Marine Engineer Operations* (Washington, US Marine Corps Headquarters, 7 May 1963), 2-3.

¹¹⁵ Ibid., 4

Vietnam and beyond: 1962 through 1975

July of 1962 marked the entry of the Marines into Vietnam. The engineer battalions were vital fixtures within the Marines throughout the war, but their primary role remained that of support. Despite the tactical application and utilization of engineers, construction remained a major portion of expected engineer support for the Marines.¹¹⁶ Between the division and tactical engineer battalions (now known as Force Engineers), the Marine engineers provided support across the full spectrum of operations, but the right engineers for the right job eluded many leaders.

Much like the Army engineers of World War II, the Marine engineers received tasks by area instead of by what their equipment and training specified. While the division engineers were better equipped and manned to perform general support, they often supported the ground forces with tactical engineer support. Likewise, the combat focused force engineers supported tasks better suited for the heavily equipped division engineers.

Despite the poor understanding of how the engineers should function, the Marine engineers performed their tasks to the best of their abilities. The division engineer battalions provided general combat support in the form of deliberate road sweeps, direct combat support to specific infantry units for such missions as search and destroy, and combat service support for such missions as base camp or landing zone construction. In addition to its tactical engineer mission of maneuver support and counter-mobility support to the infantry, the force engineer battalion performed the same tasks as the division battalion, but with the benefit of more heavy equipment and engineers. The distinction between the type of engineers and the missions their force structure design remained blurred in the Marine leadership's understanding.

¹¹⁶ This page primarily references Donnely, *History of the Marine Engineer*,; 11-12.

The Modern Marine Corps Engineer: 1976-1991

The lessons learned from Vietnam on the application and use of the Marine engineers led to a few fundamental changes in the structure of the engineers in the Marine Corps as it downsized for peace. The first notable change focused on separating the missions of the engineers in the Marine doctrine. The division engineer battalion's name changed to the combat engineer battalion in an attempt to draw a line between the tactical support they provided and the general support the force engineer battalion provided. The second major change was the creation of the Force Service Support Group (FSSG), which absorbed the force engineer battalions. This second change facilitated the G-4 requirements of engineer support in the support and sustainment element of the FMF construct.¹¹⁷ The air wing retained the specialty support engineers for electrical, water and airfield maintenance and repair.

The change in name for the combat engineer battalion, while logical, did little to change the battalion's mission, doctrine or equipment. The battalion still had the requirement to provide general engineer support on top of its tactical missions of mobility, counter-mobility and survivability to the ground force. It was still equipped with civilian heavy engineer dozers, graders and dump trucks, which gave it the appearance of the construction engineers in the FSSG. This only added to the confusion of mission capabilities and requirements for the engineers in the combat battalion and resulted in little change to the training or requirements of the Marine engineers. While the intent was to have the combat engineer performing frontline combat tasks like cutting a path through a jungle with hand tools and the force engineer to construct Main Supply Routes (MSR) through the jungle, Marine doctrine did not reflect it.¹¹⁸

¹¹⁷ Ed J. Maguire, "Complexion of Engineer Support," *Command and Staff College Report* (Headquarters, US Marine Corps, Quantico, VA, 1989), 3-4.

¹¹⁸ *Ibid.*, 3.

The basic engineer structure within the Marine Corps remained the same through the Gulf War in 1991. The engineers continued to perform essentially the same tasks with some of the same equipment they had used in World War II, the Korean War and Vietnam. While the capabilities of three engineer units within the Marine Expeditionary Force are different, the core training and expectations of engineer support capabilities remain focused on the broad spectrum of engineer support. Marine engineers must all be construction and combat capable, which has caused confusion over training priorities, support tasks and missions for engineers.¹¹⁹

The US Navy Seabee: Builders Who Fight

The relationship of the Seabees to the Marines is a topic that has already received some discussion within this paper; however, it is important to address how the naval construction battalions came to exist and what impacts policy, strategy and doctrine had on their development and their mission assignments. Additionally, the delineation in the Seabee core mission demonstrates how the mission of the fighting engineers in the Army and Marines is not entirely compatible with true construction engineer mentalities and missions.

World War II: Birth of the Seabee

The Seabee was born out of necessity after the 7 December 1941 Japanese attack on Pearl Harbor and the United States entry into the war. Prior to the attack, the Navy primarily resourced its construction needs through civilian engineer contracts. However, the use of civilian labor in war zones was impractical as it was legally not acceptable to have civilian contractors serving under such conditions. In fact, international law stated that “civilians were not permitted to resist

¹¹⁹ Ibid., 1.

enemy military attack” and any civilian resistance was punishable by charging the civilians as guerrilla fighters.¹²⁰

The requirement for a militarized navy construction capability was apparent, as the Navy needed advance bases in the Pacific project combat forces toward Japanese interests. Rear Admiral Ben Morrell of the Civil Engineer corps, USN, spearheaded the creation of a Naval construction regiment (NCB) capable of meeting the engineering needs of the Navy at war. On 28 December 1941, he requested the authority to design and man this requirement and on 5 January 1942, he received permission to recruit men from construction trades to serve in one of the three new Naval construction battalions, known as NCB.

The Naval construction battalions or elements of a battalion were subsequently attached to the Fleet Marine Force for the duration of the war. Their primary mission was to occupy and then improve the landing site as soon as general unloading began. They would improve the initial markings from the shore party, expand holding areas for supplies and move inland to establish, repair and expand forward air bases. The CB or Seabees augmented the limited capabilities of the Marine engineers and provided vital engineer expertise and heavy equipment that repaired or improved most of the US naval ports and airfields in the Pacific.

Due to this relationship with the Marines, the Seabees often operated in unsecure, forward positions with the Marines. This threat forced the Seabees to adapt and develop a self-defense organization capable of protecting not only its equipment but also its construction site

¹²⁰ Vincent Transano, “World War II” *Seabee History* (1997)
<http://www.history.navy.mil/faqs/faq67-1.htm>.

Transano's research of the Navy Seabee compiled on the naval historical webpage was instrumental in providing a credible historical study of the Seabee.

from enemy attacks. Through necessity, warrior tasks that included the use of heavy machine guns, rifles, and 60mm mortars were included in Seabee training.¹²¹

The Seabees end strength peaked at 450 units consisting of about 225,000 engineers. These units included construction battalions, regiments, special battalions, construction battalion maintenance units (CBMUs), construction battalion detachments, and pontoon assembly detachments.¹²² The expertise they provided for constructing air bases and port facilities in the Pacific was instrumental in winning the war with Japan and repairing the country's infrastructure during the US occupation after the war.

Post war: Building a Reputation

The removal of the CB from the Marines in 1947 produced a gap in Marine engineer capability that resulted in the creation of the Force Engineer battalions in the Fleet Marine Force. Despite this addition of engineer support to the Marines, the Corps determined that it would still require the support of Seabees for division landings and semi-permanent structure construction. The solution to this gap was a memorandum of agreement between the Marines and the Navy for Seabee support.¹²³

Seabees continued to build upon their reputation and skill as they maintained the forward naval bases constructed during the war while deploying detachments throughout the world to support Marine interventions. The mobility of the Seabee along with their skill and quality of construction engineer support solidified their existence in the military force structure. Unlike the Marine and Army engineers, the Seabees did not experience the debates over their value in the force. As such, their doctrine did not change much to accommodate different support

¹²¹ Ibid.

¹²² Ibid.

¹²³ Donnelly, *History of Marine Engineer*, 9.

relationships or organizational changes. The Seabee mission was vital, simple and straightforward: build and maintain forward ports, camps, and airfields in support of the Navy, Marines and Army.

Korea, Vietnam and In-between

While the contributions of the Seabees to many military successes in Korea, Vietnam and other hotspots around the world deserve discussion, their relevance to the structure of the naval construction battalion is minimal. The only change worth noting is growth as they activated their reserves to support the wars. Their component strength of about 20,000 grew to about 120,000 in 1950 as the United States intervened in Korea.¹²⁴ The Seabees returned to 20,000 after the war, continued support operations abroad with the Navy and Marines and grew once again in 1963, but only to about 40,000 serving on active duty at one time. While many Seabee units saw combat while they performed their construction mission, this was not the same focus or type of combat that the Marine and Army combat engineers performed. Seabee action mainly involved self-defense, which they performed well considering their formal training and mission centered on craftsman engineer skills and not combat.

During the Korean War, Seabees rotated duty between the United States and Korea in order to perform their maintenance and construction duties at ports, inland and airbases. The Seabees were instrumental in the success of the Inchon Landing in 1950 as they, alongside the Army engineers, built causeways and port facilities to ensure the success of the invasion. They later built roads, bridges, and airfields that supported the air and ground forces throughout Korea. In Vietnam, they fielded 21 battalions of about 11,000 men and constructed semi-permanent camps and permanent infrastructure, including airfields, ports, bridges, and roads.¹²⁵

¹²⁴ Transano, "Southeast Asia" *Seabee History*, 67-5.

¹²⁵ Ibid.

Post Vietnam through the Gulf War

While ground forces of the Army and Marines developed Air-Land Battle doctrine, the Navy Seabees continued the missions they had executed since World War II. The late 1970's and early 1980s gave the Seabees a plethora of opportunities to deploy to forward ports and disaster areas allowing them to refine their deployable force structure and maintain their individual construction expertise. In addition to their general construction skills, the Naval Construction Force includes highly desirable skills and capabilities such as well drilling, technical survey, welding, electrical, and bunker construction.

To better support the different operations and requirements abroad, the Naval Construction Regiment (NCR) designed several different engineer packages of support. They include a mix of capabilities within the construction battalion with a capability to augment with technical support to meet mission requirements. The final force structure is eight active battalions of which, three generally deploy, three remain ready to deploy for contingency operations, and two remain on high alert to deploy forces within 36 hours for emergency surge capabilities. Despite apparent changes to the naval engineer organization, the core technical engineer mission has remained the same since World War II.

The US Air Force: Technical Experts

The history of the Air Force engineer shares its roots with the construction engineers of the other services all supported military airfield construction, maintenance, and repair in World War II. However, once authorized as a separate service in 1947, the Air Force leadership knew it would require school trained engineers to design and maintain air bases. The desire to move away from their requirement of Army Corps of Engineers for funding and support further fostered this requirement as the Air Force wanted to demonstrate independence from the other services. However, by design, the Air Force and was still dependent on the Corps of Engineers for base funding and support.

This relationship with the army worked relatively well in the continental US, but soon was tested on foreign soil as the US became involved in the Korean War. The Army augmented the Air Force to meet airfield engineer requirements throughout the war with an attached force known as the Special Category Army with the Air Force (SCARWAF).¹²⁶ Engineer requirements were constant as new aircraft brought new requirements for longer, wider, and harder runways. The engineers struggled to meet mission requirements throughout the war as World War II era engineer equipment became more worn and difficult to maintain. Despite these challenges, the engineer relationship in Korea afforded valuable lessons in manning and control of the engineer assets that unfortunately would not be applied until 1964. After the signing of the armistice in Korea, the Air Force requested its own engineers to relieve dependence on the Army for support. The unintended result was the removal of all engineers from the Air Force command. Army engineers still augmented airbase maintenance and construction, but the Air Force again had to go through the Corps of Engineers for this support. World events in Lebanon, Berlin, and Southeast Asia soon demonstrated the Air Force's need for global engineer contingency capabilities.

The requirement for a skilled rapid response engineer force capable of establishing and maintaining large forward airbases in other countries, like Vietnam, resulted in the creation of the Prime Base Engineer Emergency Force (PRIMEBEEF).¹²⁷ This engineer squadron's primary mission was to establish and maintain the beddown, electrical, plumbing, air control and airfield requirements of long-term airbases both in the continental US and abroad. PRIMEBEEF squadrons met many of the initial needs of forces in Vietnam and continued to provide airbase engineer support all over the world since its creation in 1964. An additional requirement for a

¹²⁶ Rusty Vaira, "An Analysis of Civil Engineer Officer Contingency Training," *Air Force Institute of Technology* (March 2001). (accessed 15 September, 2009) <https://www.afresearch.org>, 26.

¹²⁷ This section primarily references Ronald B. Hartzer, "Foundations for the Future: A History of Air Force Civil Engineers" (Unpublished article from AFCESA) (January 2001), 2-6

self-contained, airmobile engineer force capable of building expeditionary airbases in hostile countries also emerged during this period. The result was the creation of two Rapid Engineer Deployable Heavy Operational Repair Squadron, Engineering (RED HORSE) units.

Both PRIMEBEEF and REDHORSE remained in the Air Force structure after the Vietnam War and thus gave the Air Force its own construction engineering capability. The technical requirements of the Air Force engineer remain focused on their mission to establish and maintain airbases all over the world. This resulted in an expertise and training program that requires officers to be licensed civil engineers and the airman engineers to be highly skilled and trained in their technical engineer fields. The results are engineers that are able to focus on their one general engineering mission and retain their corps skills and competencies. The Air Force, much like the Seabees, and unlike the combat engineers of the Army and Marines, are general engineering experts.

Conclusion

National strategic policy and strategic military leadership affected the engineer force structure over the last 90 years despite little change to the mission of the military engineer. Regardless of the force structure issues, engineers performed their unchanging missions of general engineering, mobility, counter mobility, and survivability in support of both their specific service branch and other services. Additionally, the requirement to provide cross-service support while supporting their specific service shaped military leaders' concept of what engineers do for the force. Unfortunately, this created a perception that all engineers are alike and that their missions are the same across services.

Prior to World War II, Army engineer force structure suffered due to an isolationist national strategy. Engineers entered World War II with the mission to provide mobility, counter-mobility, survivability and general engineering to a much heavier and more maneuverable force than they had supported in World War I. The combat arms heavy leadership in the Pentagon

incorrectly assumed there would be a smaller requirement for engineers. The results entering World War II were a high demand for engineers executing missions their training and equipment were not necessarily suited to complete. World War II also fostered the birth of the mobile and technically proficient Seabees, defined the role of the Marine engineer, and refined the relationship between the Marines and Seabees during landing operations.

Post World War II again forced changes to the engineer force structure. The Army experimented with Pentomic and ROAD structures and supported the newly created Air Force. The Marines refined their highly mobile structure and formalized their doctrinal relationship with the Seabees for landing operations. Korea tested the new Army structure and identified gaps in the support capabilities at division level for the maneuver forces. Additionally, the Korean War provided countless examples of cross-service engineer requirements as Seabees supported the Air Force, Marine engineers supported Army ground forces with general engineering, and Army engineers supported the Air Force and Marines with general and combat engineering.

After the Korean War and into Vietnam, all services looked at the future of war as it related to an atomic battlefield. The Army again looked at restructuring to a smaller, more mobile armored force, and again neglected to adequately plan for an engineer force that could support the maneuver requirements. The Marines, Seabees, and Air Force engineers continued to solidify their engineer requirements. The Marines looked to balance their requirements for general and combat engineering focus by formalizing their combat engineer battalion. The Seabees continued to perform construction at home and abroad while the Air Force severed its reliance on general engineering support from the Army with the creation of PRIMEBEEF and REDHORSE.

Post Vietnam and through Desert Storm, the Army again restructured, this time based on lessons learned from the Yom Kippur War. Air-Land Battle doctrine emerged and offered a robust combat engineer structure at the division level. General engineering support options remained under Corps and echelons above Corps control with the expectation for combat engineers to perform some general engineering tasks. The Marines maintained focus on general

engineering, but continued to develop combat engineering to support landing operations, but also expected combat engineers to perform general engineering tasks. Seabee and Air Force civil engineers further refined their role as technical experts while augmenting both Army and Marine units to meet mission requirements and fill gaps in the general engineering expertise of the ground forces.

Recommendations

As history demonstrates, the national strategic objectives will continue to influence the structure of the military, but will likely have little effect on what is required of the military engineer. The changes occurring today, as they have for the last 90 years, continue to prove the focus for military engineers must remain rooted in tasks that have made their respective services successful to date. Military leaders and planners must ensure that each service retains the fundamental engineering support their particular service requires as the military continues to eliminate redundancy of effort between the services.

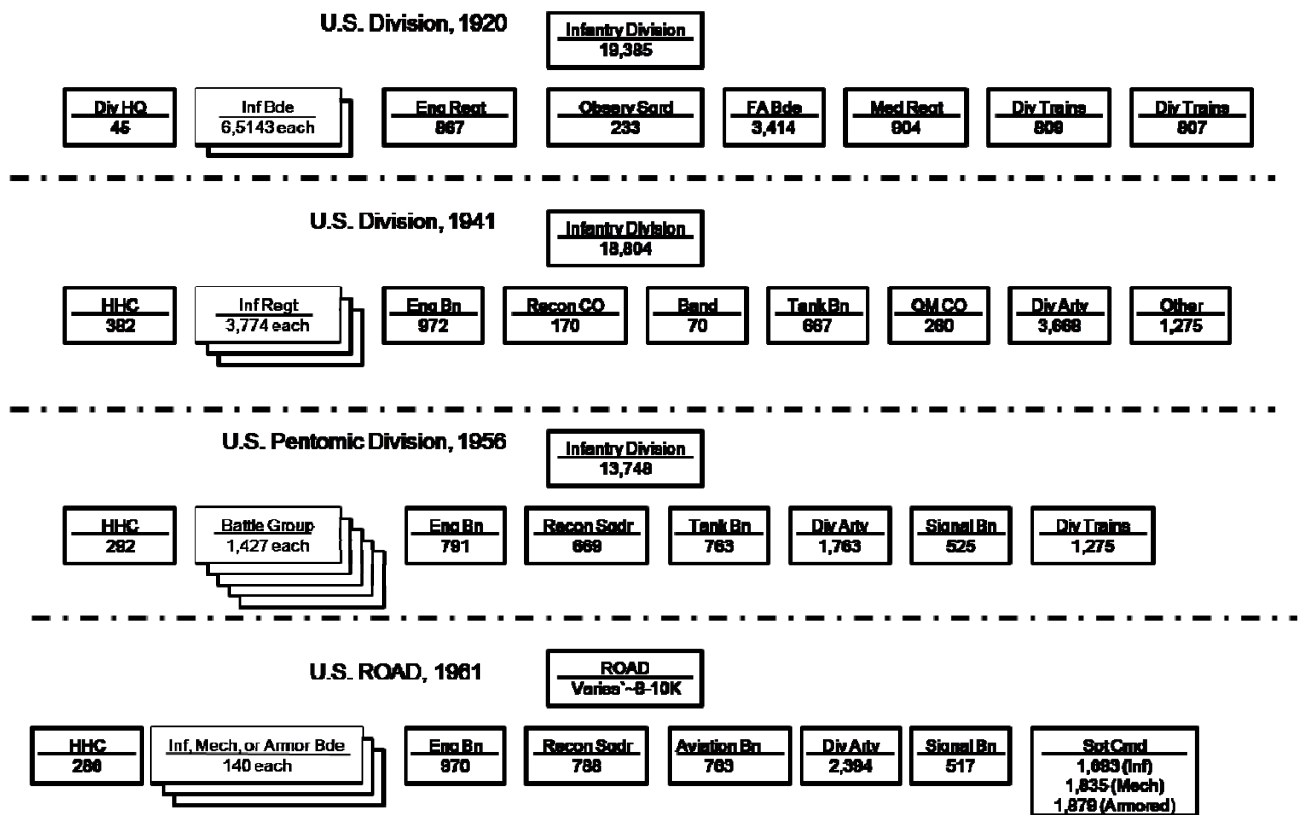
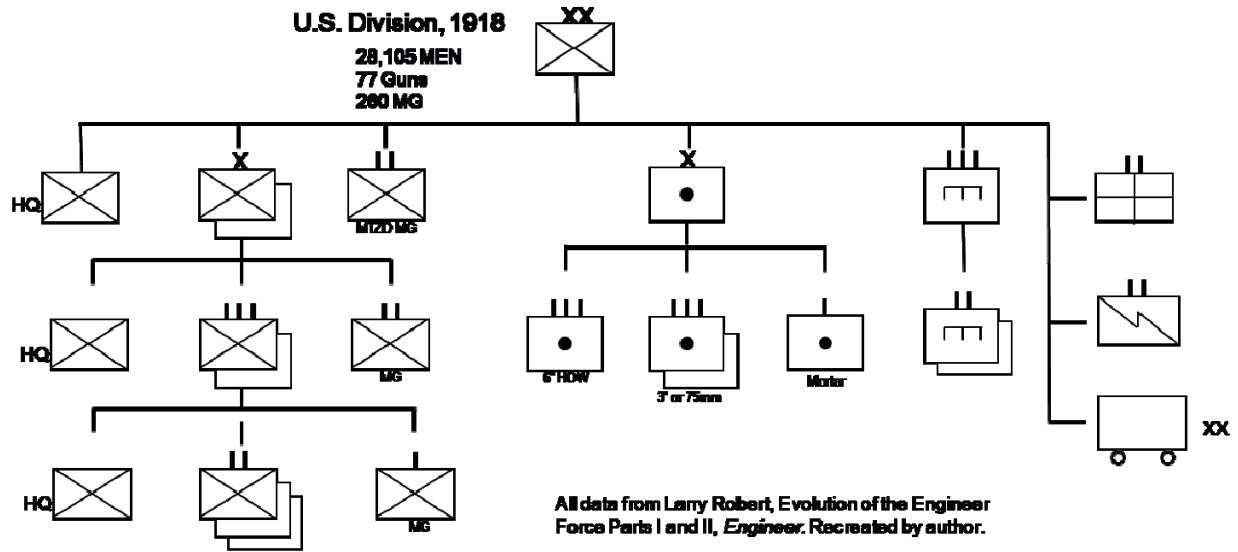
The understanding of the historical evolution of the military engineers' mission requirements deserves consideration when developing a joint approach to training and equipping all military engineers. Essentially, while the Army and Marine engineers' primary requirements evolved from a need for maneuver support, the Navy and Air Force engineers developed from a requirement for technically trained civil engineers. Here lies the basic difference between military engineering within the services. While the Marine and Army engineers require some technical engineering expertise to compliment their combat tasks, neither the Navy nor Air Force require combat engineering beyond their internal Explosive Ordnance Disposal (EOD) units.

Additionally, as military engineer technical training standardizes through ITRO and other consolidated training programs, military leaders must provide the time needed to not only master these skills, but also practice them to retain the perishable expertise. Along this line, while technical construction skills are common across the services, the focus for the Army and Marines

must remain on combat engineering to support the maneuver-centric forces. Construction skills are still required for forward lines of communication development and maintenance, but an emphasis on separation of engineer expertise between general and combat engineering within the Army and Marines will benefit the quality of engineer support. This clear delineation will enable engineer leaders within each service to better focus training and support tasks thus facilitating specialized engineers capable of doing specific tasks very well as opposed to training for everything and doing some things well.

Finally, education that fosters an appreciation of the capabilities of the service engineers is required across the spectrum of military leaders to ensure proper utilization of specific engineer skills. Maneuver commanders must be familiar with the differences between combat and general engineering and must be willing to accept advice from their engineer staff officers on the application of engineer units. Additionally, engineer offices within the services must not only understand their service specialty, but must be familiar with the other services' expertise. The knowledge encompassed from this bottom-up and top-down approach will generate better understanding of engineer capabilities and result in proper utilization of engineer expertise across the services.

Appendix A: US Army Historical Division Structures



All data from Larry Robert, Evolution of the Engineer Force Parts I and II, *Engineer*. Recreated by author.

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